भारतीय मानक
Indian Standard

IS 17853 : 2022

प्रबलित चावल दाना के उत्पादन हेतु उपकरण — विशिष्टि

Equipment for Manufacture of Fortified Rice Kernel — Specification

ICS 67.260

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भारतीय मानक ब्यूरो
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Agriculture and Food Processing Equipment Sectional Committee, FAD 20

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Agriculture and Food Processing Equipment Sectional Committee had been approved by the Food and Agriculture Division Council.

Fortified rice kernels (FRK) are rice grains fortified with micronutrient premix. The micronutrient premix is added to rice-based carrier to form fortified rice kernels using two technologies namely, extrusion and coating. Fortified kernels are blended with non-fortified rice in a ratio of 1 percent or 2 percent to produce fortified rice. In order to overcome micronutrient deficiencies in Indian population, Government of India is promoting consumption of fortified rice containing iron, folic acid and vitamin B_{12}, through various social security programmes like Public Distribution System (PDS), Integrated Child Development Scheme (ICDS), and Mid-Day Meal Scheme (PM Poshan) in Schools.

In order to strengthen the rice fortification ecosystem in the country, BIS has taken up formulation of Indian Standards on specifications for fortified rice and related commodities as well as equipment and machinery used for their manufacture to ensure consistent quality of final products. In this regard, three Indian Standards on specifications for fortified rice and related commodities have been published which are as under:

IS 17780 : 2021 Fortified rice — Specification

IS 17781 : 2021 Vitamin mineral premix for manufacturing fortified rice kernels — Specification

IS 17782 : 2021 Fortified rice kernels — Specification

This standard covers the specification for machinery used for production of fortified rice kernel through the process of extrusion. The performance requirements along with constructional specifications have been prescribed for the following equipment:

a) Micro-pulverizer,
b) Mixer,
c) Extruder, and
d) Dryer.

Another Indian Standard, IS 17854 : 2022, ‘Equipment for manufacture of fortified rice — Specification’ has also been formulated covering the requirements for equipment used for manufacture of fortified rice.

The composition of the Committee responsible for formulation of the standard is given at Annex D.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value, observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 ‘Rules for rounding off numerical values (*revised*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

EQUIPMENT FOR MANUFACTURE OF FORTIFIED RICE KERNEL — SPECIFICATION

1 SCOPE

This standard prescribes the requirements of the equipment used in production of fortified rice kernel.

2 REFERENCES

The standards listed below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards listed below:

IS No.	*Title*
228 (Relevant Parts)	Method for chemical analysis for steel
3748 : 1990	Tool and die steels — Specification (*second revision*)
17782 : 2021	Fortified rice kernel — Specification
6911 : 2017	Stainless steel plate, sheet and strip — Specification (*second revision*)
7283 : 1995	Hot-rolled bars for the production of bright bars and machined parts for engineering applications — Specification (*first revision*)
7466 : 1994	Rubber gaskets for pressure cooker — Specification (*first revision*)

3 TERMINOLOGY

For the purpose of this standard, the following terms and their definition shall apply.

3.1 Fortification — Practice of deliberately increasing the content of essential micronutrient(s), that is vitamins and minerals, in a food, so as to improve the nutritional quality of the food supply and provide a public health benefit with minimal risk to health. The essential micronutrients are added to make the food more nutritious post-harvesting. Fortification is synonymous with enrichment, and is irrespective of whether the nutrients were originally in the food before processing or not.

3.2 Fortified Rice Kernels (FRK) — Rice shaped kernels containing vitamins and minerals through extrusion or whole rice kernels coated with vitamins and minerals.

3.3 Fortified Rice — Blend of FRK and polished raw or parboiled rice in the ratio of 1 : 100 or 2 : 100 with a tolerance limit of ± 10 percent of the declared ratio.

3.4 Vitamin and Mineral Premix (VMP) — A combination of micronutrients (vitamins and minerals) in desired proportion ready for use as fortificant in the manufacturing of fortified rice kernels.

4 CONSTRUCTIONAL REQUIREMENTS

4.1 Micro-pulverizer, mixing unit, extruder and dryer are main equipment for manufacturing FRK. A schematic flowchart (Fig. 1 and Fig. 2) depicting the various process involved with FRK production is given at Annex A for guidance.

4.2 Micro-pulverizer

The capacity of micro-pulverizer shall be as per the agreement between manufacturer and purchaser. Materials of construction used shall be as per Table 1.

4.2.1 *Components of Micro-pulverizer*

a) *Hopper* — The hopper shall be suitably designed to feed the broken rice in the grinding house/chamber. Feeding arrangement may be provided to control the feed rate of broken rice in the grinding chamber. Hopper shall be provided with a magnet to trap metal impurities.

b) *Grinding Chamber* — The grinding chamber shall have following arrangements:

   1) Suitable arrangement for installation of screen and hammer.
   2) Grinding chamber suitably installed maintaining proper clearance with hammer and screen.
   3) Suitable inlet for receiving broken rice/rice and outlet for rice flour.

c) *Screen* — Suitable wear resistant screen shall enable obtaining rice flour size of less than 250 µm (preferebly 150 µm).

Table 1 Material of Construction of Micro-pulverizer

(*Clause* 4.1)

Sl No.	Component	Grade of Material	Conforming to Indian Standard
(1)	(2)	(3)	(4)
i)	Hopper	Stainless steel grade X04Cr19Ni9	IS 6911
ii)	Grinding chamber	Stainless steel grade X04Cr19Ni9	IS 6911
iii)	Screen	Stainless steel grade X04Cr19Ni9	IS 6911
iv)	Hammer	Stainless steel grade X04Cr19Ni9	IS 7283
v)	Cyclone	Stainless steel grade X04Cr19Ni9	IS 6911
vi)	Pipes and fittings	Stainless steel grade X04Cr19Ni9	IS 6911
vii)	Supporting frame	Stainless steel grade X04Cr19Ni9	IS 6911

d) *Hammer* — The hammer shall consist of:
   1) Wear resistant duly balanced special type of hammers; and
   2) Multiple hammers depending upon the capacity of the equipment.

e) *Cyclone* — The cyclone shall comply with the following:
   1) Size of the cyclone shall be in accordance with the capacity of the equipment.
   2) Suitable connecting pipes and fittings shall be provided to attach it with grinding house/chamber.
   3) Supporting frame shall be of stainless steel.
   4) Dust collecting bag/filters shall be provided to collect the fine dust releasing with exit air out of the cyclone.

f) *Control Panel* — The control panel shall consist of:
   1) Feed rate controller; and
   2) LCD/LED/HMI screen to control process parameters such as feed rate, level of grains in hopper, etc.

It may also have a supervisory control and data acquisition (SCADA) system to record feed rate, output rate, current, voltage, power, etc.

4.2.2 *General Requirements*

a) Blower of suitable size shall be provided to pass rice flour from grinder to cyclone.
b) Electric motor of suitable size shall be installed to provide required rpm to hammer and blower as per requirement.

4.2.3 *Performance Requirements*

a) Average particle size of rice flour shall be less than 250 µm (preferably below 150 µm).
b) Rice flour obtained after pulverization shall be free from metal or foreign impurities.

4.3 Mixing Unit (Powder-Mixer)

4.3.1 Mixer shall be single/twin shaft paddle blender or double helical ribbon blender. The capacity of mixer shall be as per the agreement between the manufacturer and the purchaser.

4.3.2 Mixing chamber may be U-shaped for single shaft or W-shaped for twin shaft.

4.3.3 It shall be provided with water spray arrangement.

4.3.4 It shall be provided with lump breaking arrangement to break the lumps formed during mixing.

4.3.5 Paddles, if provided shall have square or rectangular or triangular paddle with connecting rod suitably mounted on the shaft.

4.3.6 Cover/lid shall be provided with a food-grade gasket to avoid spillage of material.

4.3.7 Water dosing unit of mixing unit should be provided with:

a) Suitable arrangement to spray water,
b) Water dosing pump, and
c) Automatic flow control system.

4.3.8 Mixing unit should be provided with automatic feeding unit (VMP dosing unit) for VMP mixture.

4.3.9 Control panel of mixing unit shall be provided with,

a) Control for shaft speed, water flow rate, VMP and additives dosing; and
b) LCD/LED/HMI screen to set and control process parameters.

It may also have a SCADA system to record feed rate, output rate, current, voltage, power, etc.

4.3.10 Materials to be used in components of mixer shall be as per Table 2.

Table 2 Material of Construction Used in Components of Mixing Unit

(*Clause* 4.3.10)

Sl No. (1)	Component (2)	Grade of Material (3)	Conforming to Indian Standard (4)
i)	Mixing chamber	Stainless steel grade X04Cr19Ni9	IS 6911
ii)	Cover/lid	Stainless steel grade X04Cr19Ni9	IS 6911
iii)	Shaft	Stainless steel grade X04Cr19Ni9	IS 6911
iv)	Paddle	Stainless steel grade X04Cr19Ni9	IS 6911
v)	Helical ribbon	Stainless steel grade X04Cr19Ni9	IS 6911
vi)	Gasket	Food grade rubber	IS 7466
vii)	Supporting frame and structure	Stainless steel grade X04Cr19Ni9	IS 6911

4.3.11 Suitable size of electric motor shall be installed to provide required rpm to the shaft of the mixer.

4.3.12 *Performance Requirements*

The mixer shall ensure proper mixing operation such that:

a) Iron, folic acid and vitamin B_{12} are blended uniformly in the mixture;
b) Moisture distribution is uniform without lumps; and
c) The final mixture is free from the metal impurities as per the test method given in Annex B.

4.4 Extruder

4.4.1 *Components of Extruder*

a) *Barrel* — Barrel of square or circular type may be used. Suitable heaters should be used in each section to heat the barrel at a given temperature. The temperature should be automatically controlled as per the set conditions.
b) *Screw* — Extruder may be provided with single or multi-screw element positioned on the shaft. It should be properly designed to convey material from feed to die section. It should be wear-resistant, suitable to sustain high pressure.
c) *Feeder* — Feeder of extruder shall be of single/twin-screw type with precise control depending upon the capacity. It shall be provided with suitably designed hopper to deliver wet material to screws.
d) *Die Head* — Die head of extruder shall be suitably designed to hold die. It shall be provided with temperature and pressure sensor.
e) *Die and Cutter* — Die and cutter of extruder be specific for rice variety. The die opening shall be such that kernels should not stick together while cutting. The cutter speed shall be adjustable with rated extruder screw speed.

4.4.2 Control panel of the extruder shall be provided with:

a) Control system for temperature, screw speed, feed rate, cutter speed; and
b) LCD/LED/HMI screen to control process parameters.

The extruder may also be provided with SCADA system to record torque, die pressure, barrel zone, die head temperature, cutter speed, output capacity.

4.4.3 *Performance Requirements*

The size and weight of FRK obtained from extruder should be uniform.

4.4.4 The material of extruder shall be as per Table 3.

4.4.5 *General Requirements*

a) Electric motor of suitable size shall be installed to provide required rpm to operate extruder, feeding screw and cutter;
b) Extruder shall have provision of heating and cooling; and
c) Extruder shall be equipped with temperature sensors at each zone.

4.5 Dryer

4.5.1 The dryer shall be of continuous electrical type with multilayer vibratory arrangement of required capacity as agreed between the manufacturer and the purchaser.

4.5.2 *Requirements*

a) Dryer shall perform in such a way that colour change and fissure formation shall be avoided.
b) Belt of dryer shall be made of food grade material.
c) Dryer shall have suitable heating and cooling arrangement to control temperature and relative humidity.
d) Blower of suitable size shall be installed for controlling the airflow in the dryer.

Table 3 Material of Construction for Extruder

(*Clause* 4.4.4)

Sl No. (1)	**Component** (2)	**Material Used** (3)	**Conforming to Indian Standard** (4)
i)	Barrel	Wearing, abrasion and corrosion resistant, food grade nitriding steel of grade EN41B or 38CrMoAl or any other similar material	Annex C of this standard
ii)	Extruder screw	Wearing, abrasion and corrosion resistant, food grade nitriding steel of grade EN41B or 38CrMoAl or any other similar material	Annex C of this standard
iii)	Die head	Wearing, abrasion and corrosion resistant, food grade nitriding steel of grade EN41B or 38CrMoAl	Annex C of this standard
iv)	Die	Stainless steel of grade X04Cr19Ni9N or Die steel	IS 6911 IS 3748
v)	Cutter	Stainless steel of grade X04Cr19Ni9	IS 6911
vi)	Body cover	Stainless steel of grade X04Cr19Ni9	IS 6911
vii)	Supporting frame and structure	Stainless steel of grade X04Cr19Ni9	IS 6911

e) Dryer shall be equipped with temperature sensors, airflow meter and relative humidity (RH) sensors.

4.5.3 Control panel of the dryer shall be provided with:

a) Control system for temperature, air velocity and relative humidity; and

b) LCD/LED/HMI screen to set and control the process parameters.

The dryer may also be provided with SCADA system to record temperature, air velocity and relative humidity.

4.5.4 *General Requirements*

Suitable size of electric motor shall be installed to operate belt conveyors and blowers of the dryer.

4.5.5 *Performance Requirements*

a) The FRK obtained after drying shall not have more than 12 percent moisture by mass.

b) The FRK obtained after drying shall be free from fissures.

c) The FRK obtained after drying shall not show any colour change in FRK.

d) The FRK obtained after drying shall be free from metal impurities and foreign matter.

4.5.6 A magnetic-separator arrangement should be provided to check for metallic matter or any other arrangement or equipment required to produce FRK as per IS 17782.

5 MARKING

5.1 Each equipment shall be legibly and indelibly marked with the following particulars:

a) Manufacturer’s name or recognized trademark, if any;

b) Batch or serial number and date of manufacture;

c) Capacity; and

d) Proper safety signs.

5.2 BIS Certification Marking

The product(s) conforming to the requirements of this standard may be certified as per the conformity assessment schemes under the provisions of the *Bureau of Indian Standards Act*, 2016 and the Rules and Regulations framed thereunder, and the products may be marked with the Standard Mark.

ANNEX A

(*Clause* 4.1)

(*Informative*)

SCHEMATIC FLOWCHART OF THE VARIOUS PROCESSES INVOLVED IN FRK PRODUCTION

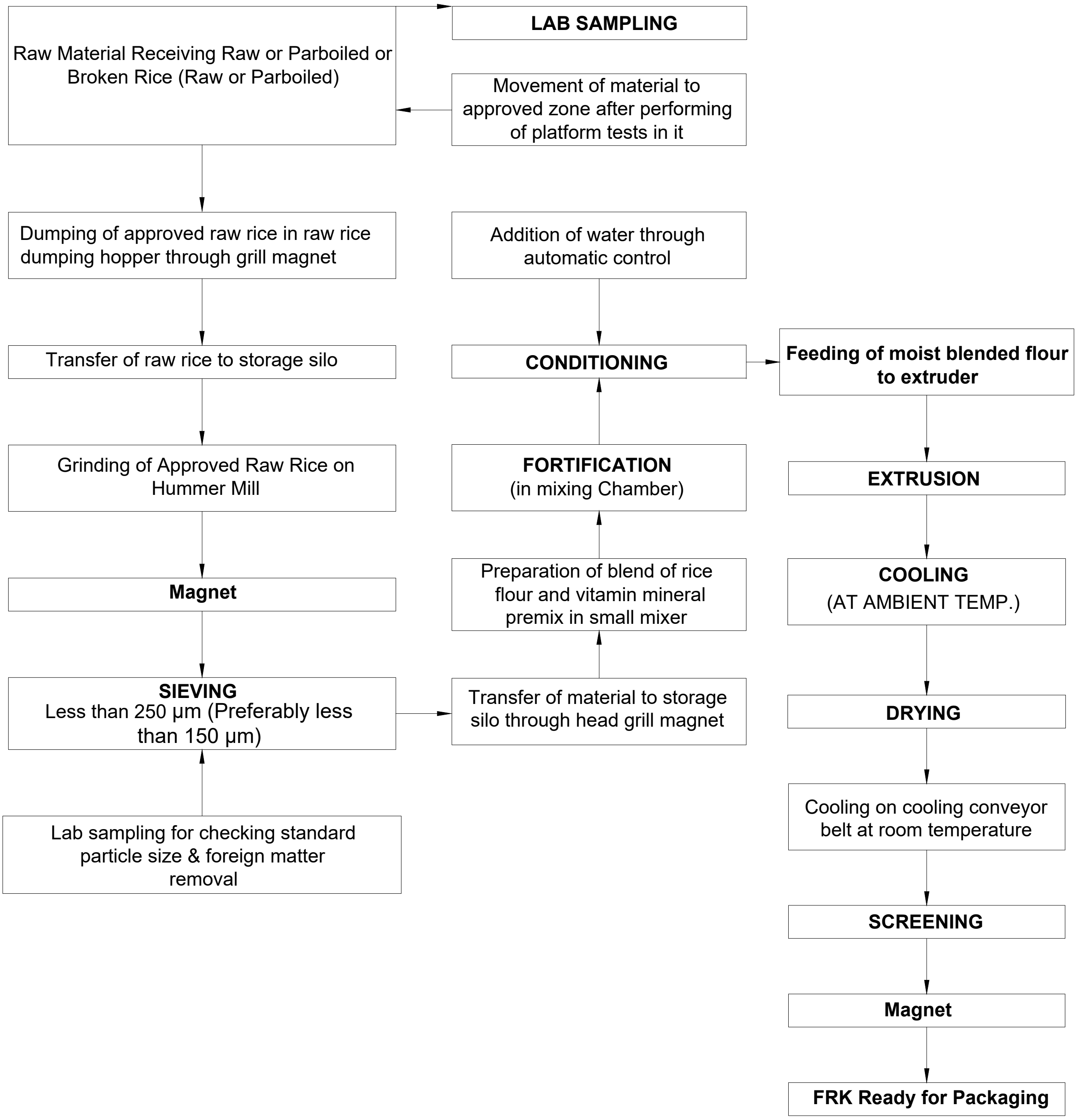
Raw Material Receiving Raw or Parboiled or Broken Rice (Raw or Parboiled)
LAB SAMPLING
Movement of material to approved zone after performing of platform tests in it
Dumping of approved raw rice in raw rice dumping hopper through grill magnet
Transfer of raw rice to storage silo
Grinding of Approved Raw Rice on Hummer Mill
Magnet
SIEVING Less than 250 µm (Preferably less than 150 µm)
Lab sampling for checking standard particle size & foreign matter removal
Addition of water through automatic control
CONDITIONING
FORTIFICATION (in mixing Chamber)
Preparation of blend of rice flour and vitamin mineral premix in small mixer
Transfer of material to storage silo through head grill magnet
Feeding of moist blended flour to extruder
EXTRUSION
COOLING (AT AMBIENT TEMP.)
DRYING
Cooling on cooling conveyor belt at room temperature
SCREENING
Magnet
FRK Ready for Packaging

FIG. 1 MATERIAL AND PROCESS FLOW CHART FOR MANUFACTURE OF FRK

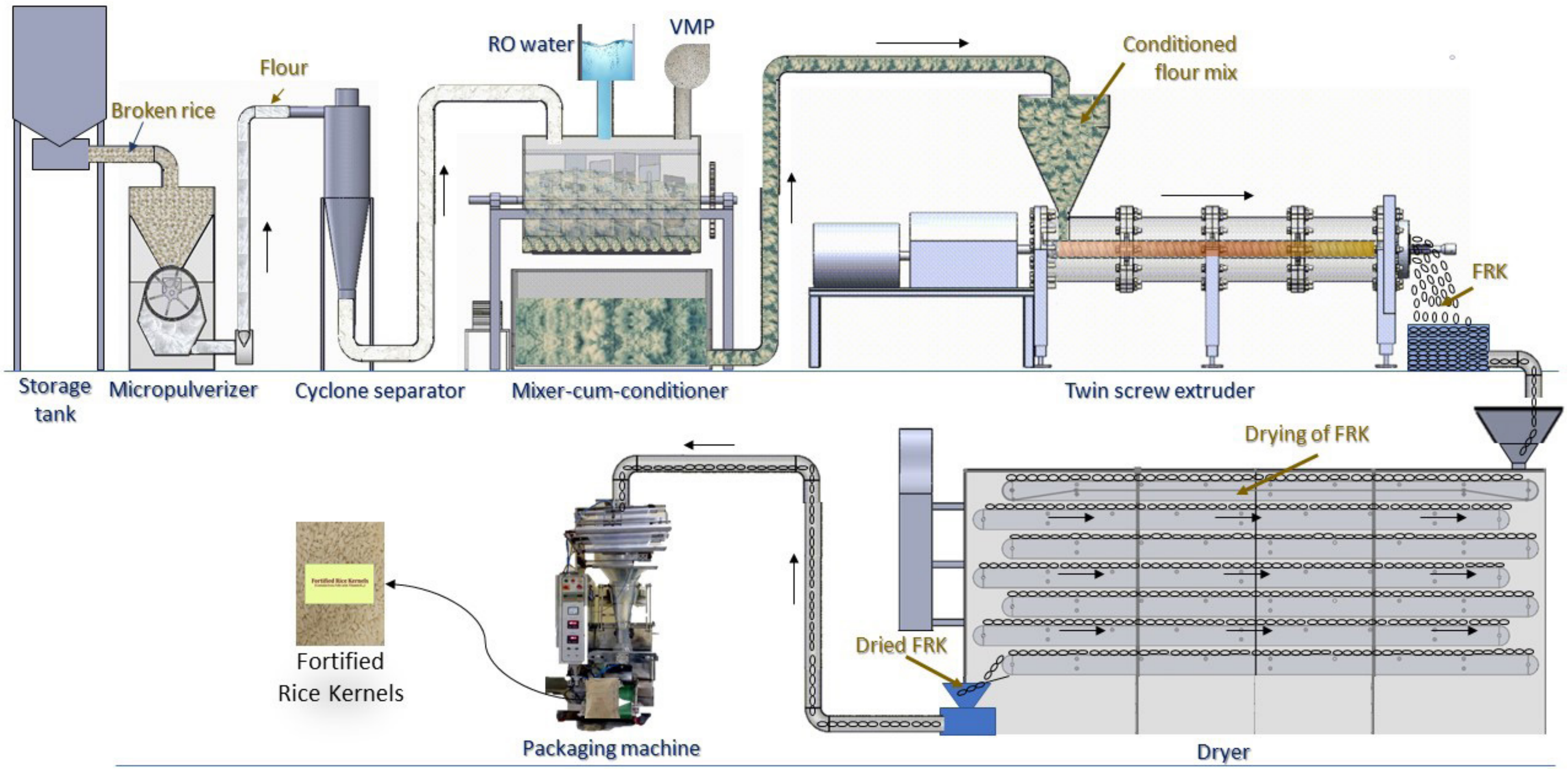

Fig.2 Schematic of Plant Equipment and Machinery Required in The Manufactue of FRK

ANNEX B

(*Clause* 4.3.12)

DETERMINATION OF CONTENT OF IRON PARTICLES

B-1 PROCEDURE

A known amount of (25 g) mixed flour is spread evenly on a petridish. A powerful magnet wrapped in polythene sheet is run over the sample repeatedly to collect the iron filings/particles. The presence of iron filing/particle shows compromise of critical control parameter, and hence in the efficacy of the magnet used at various control points. Hence, at the end of the test no iron filing/particle shall be present.

ANNEX C

(*Table* 3)

WEARING, ABRASION AND CORROSION RESISTANT, FOOD GRADE NITRIDING STEEL PROPERTY

C-1 CHEMICAL PROPERTIES

C-1.1 The steel shall conform to the following chemical composition (in percent):

C	0.35-0.42
Si	0.20-0.45
Mn	0.30-0.60
Cr	1.35-1.65
Md	0.15-0.25
Al	0.7-1.1
P	0.035, *Max*
S	0.035, *Max*

C-1.2 The analysis of the steel shall be carried out according to IS 228 and its relevant parts or any other established instrumental/chemical method. In case of dispute, the procedure given in IS 228 and its relevant parts shall be referee method.

ANNEX D

(*Foreword*)

COMMITTEE COMPOSITION

Agriculture and Food Processing Equipments Sectional Committee, FAD 20

Organization	*Representative(s)*
In Personal Capacity, Tiruchivappalli	Dr K. Alagusundaram (***Chairman***)
Agriculture Machinery Manufacturers Association, Pune	Dr Surendra Singh Shri Kashinathsa V. Kabadi (*Alternate*)
CCS Haryana Agricultural University, Hisar	Dr Ravi Gupta
Essen Multipack Limited, Rajkot	Shri Shaildip Wagh
ICAR-Indian Institute of Horticultural Research, Bengaluru	Dr A. Carolina Rathina Kumar Dr S. Bhuaneswari (*Alternate*)
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Indosaw Industrial Products Private Limited, Ambala Cantt	Dr V. H. Kalbande
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National Committee on Plasticulture Applications in Horticulture, New Delhi	Shri Anand Zambre
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Northern Region Farm Machinery Training and Testing Institute, Hisar	Shri Mukesh Jain
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Member Secretary

Shri Pawan Kumar
Scientist ‘C’ (FAD), BIS

Panel on Development of Standard on Extruder and Blender for Manufacturing FRK/Fortified Rice, FAD 20/P14

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World Food Program, New Delhi	Dr Shariqua Yunus Khan

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